Chemical characteristics and nutritive values of three oat varieties for ruminants

Zhiyuan Niu[1], Brian G. Rossnagel[2], Peiqiang Yu[1]

[1]Department of Animal and Poultry Science, and [2]Crop Development Centre
University of Saskatchewan

Summary

The objectives of this study were to determine the magnitude of differences among oat varieties of in terms of detailed chemical and nutritional characteristics (including: 1) chemical composition, 2) total digestible nutrient (TDN) and energy values at maintenance and production level for both dairy and beef cattle, 3) protein and carbohydrate subfractions, 4) in situ degradation kinetics of components, and 5) nutrient supply/availability) and provide detailed feeding values for ruminants. Six oat samples comprised of 3 cultivars (CDC Dancer, Derby and CDC SO-I) grown over two years (2005 and 2006) were obtained from the Crop Development Centre at the University of Saskatchewan. The samples were analyzed for DM, CP, EE, GE, starch, ash, NDF, ADF, ADL, NDICP, ADICP, SCP and NPN. Total digestible nutrient (TDN) and energy values (TDN1x, DE3x, ME3x, NE_L3x, DE4x, ME4x, NE_L4x of dairy, ME, NEm and NEg of beef) at maintenance and production levels for both dairy and beef cattle were determined using NRC-2001 and NRC-1996 chemical approaches. Protein and carbohydrate fractions were determined using the CNCPS system. Rumen degradation kinetics (DM, CP and starch) were determined in situ. The nutrient supply/availability will be estimated using the DVE/OEB system and NRC-2001 model. Detailed chemical composition, TDN and energy values and CNCPS protein and carbohydrate fractions are reported here. The information obtained from this study will be useful for oat breeders and feed industry.

Abbreviations: **ADF**, acid detergent fibre; **ADICP**, acid detergent insoluble crude protein; **ADL**, acid detergent lignin; **CDC**, Crop Development Centre; **CNCPS,** the Cornell Net Carbohydrate protein System; **CP**, crude protein; **DE**, digestible energy; **DM**, dry matter; **ED**, effective degradability; **EE**, ether extract; **GE**, gross energy; **NDF**, neutral detergent fibre; **NDICP**, neutral detergent insoluble crude protein; **NE**, net energy; **NE_L**, net energy for lactation; NEm, net energy for maintenance; **NFC**, non-fibre carbohydrate; **NPN**, non-protein nitrogen; **PA=NPN,** fraction of CP solublized at the time zero; **PB1,** soluble true protein, a fraction of CP that is soluble in borate-phosphate buffer and precipitated with sodium tungstate, it is estimated by subtracting NPN from soluble CP; **PB2,** neutral detergent soluble but not buffer soluble, it is fermentable in the rumen at a lower rate than buffer soluble fraction, it is estimated by buffer insoluble CP minus NDICP; **PB3,** insoluble in neutral detergent but soluble in acid detergent, slowly degradable true protein=NDICP-ADICP; **PC=ADICP,** indigestible protein; **RUP**, ruminally undegraded feed protein; **SCP**, soluble crude protein; **tdCPc**, truly digestible crude protein for concentrate; **tdFA**, truly digestible fatty acid; **TDN**, total digestible nutrient; **tdNDF**, truly digestible neutral detergent fibre; **tdNFC**, truly digestible non-fibre carbohydrate; TMR, total mixed ration; **TP**, true protein.

INTRODUCTION

Oat is of the genus *Avena*, family Gramineae (grass family), and thrives in moist, temperate regions of the world, though they may be cultivated in a variety of climates (Heiser, 1973). The most widely cultivated species is the *Avena sativa,* a cereal grass used for food and fodder.

Oat samples vary considerably in nutrient composition. Much of the variation arises from genotype, growth environment, and interaction between environment and genotype. Other differences may result from harvest conditions, storage, and post-harvest treatments or other processes that the crop is subject to before final use. Further apparent differences in composition may be a result of variation in analytical methods (Fuhr, 2006).

Early studies indicated that oat used as an energy source for dairy cattle had no advantage over other cereal grains (Fisher and Logan 1969; Tommervik and Waldern 1969; Schingoethe et al. 1982; Moran 1983; Moran 1986; Martin and Thomas 1987) due to high hull content ranging from 20 to 30% (Crosbie et al. 1985). Oat hulls are fibrous and contain substantial amounts of indigestible lignin. Lignin impedes the digestion of associated nutrients. However, oat has higher lipid content and can have an advantage over other cereals in terms of energy content (Fuhr, 2006).

In situ degradability of DM, CP and starch of oat was studied by Herrera-Saldana et al. (1990). They observed that oat had highly degradable DM, CP and starch, about 80% DM and greater that 90% of total CP and starch in oat disappeared during first 2 h of rumen incubation.

Recent developments by The Crop Development Centre, University of Saskatchewan has showed promise for oat use in dairy rations. This type of oat contains low-lignin hull (LLH) and high-fat groat (HOG), and is low in acid detergent lignin (ADL) and has greater ruminal degradability, thus, LLH-HOG oat should be a superior oat for feeding dairy cattle (Fuhr, 2006).

The objectives of this study were to determine the magnitude of differences among the 3 cultivars (CDC Dancer, Derby and CDC SO-I) in terms of their detailed chemical and nutritional characteristics (including: 1) chemical composition, 2) total digestible nutrient (TDN) and energy values at maintenance and production level for both dairy and beef cattle, 3) protein and carbohydrate subfractions, 4) in situ degradation kinetics of components, and 5) nutrient supply/availability) and provide detailed feeding values for ruminants. It was hypothesized that LLH-HOG oat (CDC SO-I) have superior nutritional characteristics for dairy cows when compared to conventional oat.

MATERIALS AND METHODS

Oats samples

Six oat samples, the cultivars CDC Dancer, Derby and CDC SO-I grown over two years (2005 and 2006) were provided by the Crop Development Centre, University of Saskatchewan.

Sample preparation

The samples were ground through 0.5 mm and 1 mm pore size screens (Retsch ZM-100, Brinkmann Instruments Ltd., Ontario, Canada) for chemical analysis. The samples ground through 0.5 mm were for starch, and 1 mm for other chemical analyses. For rumen in situ work, the oats were processed through 0.533 mm roller mill (Sven Products, Apollo Machine and Products Ltd. Saskatoon, Canada) at the engineer lab, University of Saskatchewan.

Animal and diets

Three Holstein dry cows fitted with rumen cannula with an internal diameter of 10 cm were used for determination of rumen degradation of nutrients. The cows were housed at a tie stall at the experimental station at the University of Saskatchewan, Saskatoon, Saskatchewan, Canada. The cows were fed twice daily at 8:00 and 16:00 by receiving 14 kg (7 kg at each feeding time) of total mixed ration (TMR), consisting of 56.82% barley silage, 10.23% alfalfa hay, 4.54% dehydrated alfalfa pellets, 21.59% standard dairy concentrate (Table 1) and 6.82% fresh cow concentrate (Table 2). Water was always available. The cows were allowed for free access to the exercise grounds inside and outside. The animals used in the experiment were cared for in accordance with the guidelines of the Canadian Council on Animal Care (1993).

Table 1. Standard Dairy Concentrate[1,2]

Ingredient	%
Barley	56
Wheat	5
Oats	5
Dairy supplement pellets	33
Molasses	1

[1]Grains were dry rolled and mixed with supplement pellets.
[2]Proximate composition: 18.5% crude protein, 0.7% calcium, 0.8% phosphorus (DM basis).

Table 2. Fresh Cow Concentrate[1,2]

Ingredient	%
Barley	51.05
Oats	5.0
Canola meal	11.6
Soybean meal	10.0
Wheat distillers dried grains	9.0
Corn gluten meal	3.0
Molasses	2.5
Golden flakes3	2.5
Canola oil	0.5
Mineral-vitamin mix4	3.0
Niacin-magnesium mix5	0.3
Cobalt-iodized salt	0.6
Sodium bicarbonate	0.6
Ground limestone	0.3
Dynamate	0.05

[1]0.48 cm (3/16") pellets
[2]Proximate composition: 22% crude protein, 0.9% calcium, 0.85% phosphorus (DM basis).
[3]Dried fat supplement (Malaysian palm oil) distributed in Western Canada by Prairie Micro-Tech Inc., Regina, Saskatchewan.
[4]Formulated to provide 45 mg manganese, 63 mg zinc, 17 mg copper, 0.5mg selenium, 11000 I.U. vitamin A, 1800 I.U. Vitamin E per kg of dairy concentrate. The mix also contributes 0.14% magnesium, 0.48% calcium, 0.26% phosphorus, 0.23% sodium and 0.38% chloride to the total dairy concentrate. Prepared by Federated Cooperatives Ltd., Saskatoon, Saskatchewan.
[5]Formulated to provide one gram of niacin and 0.3 grams of magnesium per kg of fresh cow concentrate.
[6]Contains 22% sulphur, 18% potassium, 11% magnesium (International Minerals and Chemical Corp., Mundelein, ILL).

In situ rumen incubation

Rumen degradation of nutrients for all oat samples was evaluated using the in situ technique. Incubation of all treatments in the rumen was conducted with number-coded nylon bags with pore size 43 µm. Roller milled oat samples were weighed (about 7 g) into bags, and the bags were tied about 2 cm below the top, allowing a ratio of sample size to bag surface area of 27.8 mg cm^{-2}. Incubations were performed according to the gradual addition/all out schedule. Bags containing samples were inserted at 21:00 (day 1, for 48 h), 21:00 (Day 2, for 24h), and 9:00, 13:00, 17:00, 19:00 and all removed at 21:00 day on day 3. The experiment was duplicated and labelled as Run 1 and Run 2.

After incubation and removal from the rumen, all bags were rinsed with cold tap water to remove excess ruminal contents and microbes on the surface to terminate microbial activity. The bags, including 0 h incubation samples, were hand washed with cold tap water and subsequently dried in a forced-air oven at 55°C for 48 h. Residues from the same Run were pooled according to treatment, and subsequently ground through 1 mm screen for analysis of dry matter (DM), crude protein (CP), and 0.5 mm screen for analysis of starch using Retsch grinder (Retsch ZM-1, Brinkmann Instruments Ltd., Ontario, Canada).

Chemical Analysis

DM was determined by oven drying (AOAC 930.15), crude fat by diethyl ether extraction (AOAC 954.02), and ash by 600C oven according to procedures of Association of Official Analytical Chemists 1990. CP (Nx6.25) was determined by titration [(AOAC984.13) 1990] using a Kjeltec Auto Analyzer 1030 (Tecctor AB, Sweden). Starch was analyzed by enzymatic hydrolysis and spectrometry using the Megazyme total starch kit according to McCleary et al. (1997). Neutral detergent fibre (NDF) and acid detergent fibre (ADF) were determined using Ankom Fibre Analyzer (Ankom Technology Corporation, Fairport, NY) by incubating samples in neutral detergent solution (Van Soest et al. 1991) and acid detergent solution (AOAC, 1990). Acid detergent lignin (ADL) was determined by washing ADF residue with 20N H2SO4 (AOAC, 1990). Buffer soluble crude protein (SCP) was determined according to Roe et al (1990). Non-protein nitrogen was determined by the methods of Licitra et al. (1996). Total nitrogen of NDF and ADF residues were analyzed for neutral (NDICP) and acid (ADICP) detergent insoluble detergent crude protein respectively (Licitra et al. 1996). The difference between buffer insoluble crude protein and NDICP was used to estimate the true protein (TP).

The Carbohydrate (CHO) and true protein were calculated according to formula of the NRC dairy (2001) and NRC Beef (1996).

Sub-fractions of protein and carbohydrate

The CP and CHO were further partitioned using the Cornell Net Carbohydrate protein System (CNCPS) according to methods (Sniffen et al. 1992; Licitra et al. 1996; Yu et al., 2003).

The characterization of the CP fractions in CNCPS is as follows: fraction A is NPN; fraction B is true protein; and fraction C is unavailable protein. Fraction B is further divided into three fractions (PB1, PB2 and PB3) that are believed to have different rates of degradation in the rumen.

PB1is a fraction of CP that is soluble in borate-phosphate buffer and precipitated with sodium tungstate. It is estimated by subtracting NPN from soluble CP. PB2 is a fraction of true protein, soluble in neutral detergent but not soluble in buffer, it is fermentable in the rumen at a lower rate than buffer soluble fraction, and some of the PB2 escapes to lower gut. It is estimated by buffer insoluble CP minus NDICP. PB3 is insoluble in neutral detergent but soluble in acid detergent, slowly degradable true protein in the rumen because of its association with the plant cell wall, a large portion of PB3 escapes the rumen. It is estimated by the difference of NDICP and ADICP.

Carbohydrate was divided into: a rapidly degradable fraction (CA), intermediately degradable fraction (CB1), a slowly degradable fraction (CB2) and unfermentable fraction (CC).

Estimation of energy values

The energy values of TDN1x, DE3x, ME3x, NE_L3x, DE4x, ME4x, NE_L4x were estimated using the NRC Dairy (2001) and Weiss et al. (1992), and ME, NEm and NEg were estimated from NRC Beef (1996).

Statistical analysis

Statistical analyses were performed using Proc mixed model procedure of SAS (2005). The treatment means were separated using Fisher's LSD test (Steel and Torrie, 1980) with significance set at $P<0.05$.

RESULTS AND DISCUSSION

Chemical composition

CDC SO-I oat had similar chemical composition in DM, NDF, ADF, starch, CP, NPN, SCP, ADICP and NDICP to CDC Dancer and Derby. However, it was higher in ash, EE and cellulose, and lower in CHO, OM, ADL and NFC (Table 3). The results indicated that CDC SO-I had more digestible fibre than conventional oat due to its lower lignin and non fibre carbohydrate. Most of the chemical composition data, especially that for Derby, was close to values in NRC dairy (2001) and NRC beef (1996). However, lignin contents were 3.91, 3.60 and 2.12% for CDC Dancer, Derby and CDC SO-I, respectively, while the NRC dairy (2001) value is 4.9%, while Fuhr (2006) reported that the lignin content of Derby and LLH-HOG at 2.6% and 1.1% of DM, respectively. Our lignin results were intermediate to those values.

NDF, ANF and ADICP values are similar to those of the NRC Dairy (2001) and Herrera-Saldana et al. (1990) who reported that NDF, ADF and ADICP of oat were 24.0, 16.5 and 0.3% of DM, respectively. NRC Dairy (2001) values were 30.0, 14.6 and 0.3% of DM for NDF, ANF and ADICP, respectively.

Although NDF content of CDC SO-I was about 5.3% and 3.2% higher than that of CDC Dancer and Derby, the difference was not statistically significant, and it was considerably lower than 38.0% reported by Fuhr (2006) using a different LLH-HOG prototype sample. These results suggest that hull content of CDC SO-I is greater than that of Derby, in particular CDC Dancer. A future breeding goal is to reduce the hull percentage and then NDF content of LLH-HOG oat to levels similar to CDC Dancer.

Table 3. Chemical composition of different cultivar of oats (*Avena sativa*)

	Oats					
	CDC Dancer	Derby	CDC SO-I		P value	
Items				SEM	Oat	Year
DM (%)	93.88	93.88	94.08	0.185	0.711	0.848
Ash (%DM)	3.17 b	3.15 b	3.59 a	0.053	0.045	0.075
OM (%DM)	96.83 a	96.85 a	96.41 b	0.053	0.045	0.075
EE (%DM)	4.57 b	4.01 b	5.85 a	0.153	0.026	0.267
FA (%DM)	3.57 b	3.01 b	4.85 a	0.153	0.026	0.267
CHO (%DM)	80.45 a	81.75 a	77.77 b	0.420	0.041	0.203
NDF (%DM)	26.55	28.61	31.85	1.125	0.151	0.728
ADF (%DM)	11.83	13.93	13.92	0.520	0.155	0.789
ADL (%DM)	3.91 a	3.60 a	2.12 b	0.185	0.036	0.597
Hemicellulose (%DM)	14.68	14.72	17.92	0.819	0.163	0.535
Cellulose (%DM)	7.92 b	10.34 a	11.81 a	0.376	0.035	0.919
ADL (%NDF)	14.75 a	12.55 b	6.45 c	0.231	0.003	0.114
ADF (%NDF)	44.65	48.65	43.72	1.338	0.206	0.434
Starch (%DM)	45.76	40.31	42.57	2.050	0.359	0.583
NFC (%DM)	55.13 a	53.9 a	46.76 b	0.608	0.018	0.223
NFC (%CHO)	68.53	65.95	60.13	1.001	0.051	0.559
Starch (%NFC)	83.09	74.78	91.09	4.702	0.250	0.430
CP (%DM)	11.82	11.10	12.81	0.294	0.106	0.342
NPN (%CP)	13.43	9.88	15.62	1.569	0.227	0.118
NPN (%DM)	1.59	1.09	2.01	0.239	0.214	0.189
NPN (%SCP)	30.89	21.61	29.38	3.674	0.352	0.181
SCP (%CP)	43.43	46.05	53.13	2.394	0.186	0.674
SCP (%DM)	5.13	5.12	6.8	0.362	0.123	0.972
ADICP (%CP)	5.07	4.57	4.18	1.636	0.932	0.941
ADICP (%DM)	0.60	0.51	0.54	0.196	0.942	0.896
NDICP(%CP)	10.41	6.95	6.50	1.885	0.437	0.603
NDICP(%DM)	1.23	0.77	0.83	0.216	0.423	0.513

SEM=standard error of mean. Means with the different letters in the same row are significantly different ($P<0.05$).

Energy content

Analyzed gross energy and predicted energy content are shown in Table 4. A summative method was used to derive TDN1x, DE3x, ME3x, NE_L3x, DE4x, ME4x, NE_L4x using the NRC Dairy (2001) and Weiss et al. (1992), ME, NEm and NEg were estimated from NRC Beef (1996). CDC SO-I oat had similar gross energy values as CDC Dancer and Derby, but higher tdNDF and tdFA and lower tdNFC. There was no difference in predicted energy values at 1x, 3x and 4x production levels between CDC SO-I and conventional oat. The results indicated that CDC SO-I had higher truly digestible neutral detergent fibre and lower truly digestible non-fibre carbohydrate. Gross energy values were in agreement with the work of Fuhr (2006) reported as 4.649 and 4.714 Mcal/kg for Derby and LLH-HOG, respectively. The tdNDF was lower than that of reported value by the same author.

Calculated energy values for CDC SO-I were similar to those reported by Yu et al. (2003) and NRC values for barley (Dairy 2001, Beef 1996), suggesting that CDC SO-I could be an alternative to barley as a potential energy source in dairy and beef ration.

Table 4. Predicted energy value (Mcal/kg DM) of different cultivar of oats

	Oats				P value	
Items	CDC Dancer	Derby	CDC SO-I	SEM	Oat	Year
General Energy						
GE (Mcal/ kg DM)	4.5748	4.5652	4.6018	0.01116	0.2183	0.6258
Digestible nutrients (NRC, 2001)						
tdNDF (%DM)	11.44b	13.55b	18.06a	0.357	0.0111	0.4221
tdNFC (%DM)	56.19a	54.94a	47.66b	0.621	0.0179	0.2218
tdCPc (%DM)	11.58	10.90	12.59	0.304	0.1136	0.3667
tdFA (%DM)	3.57b	3.01b	4.85a	0.153	0.0259	0.2665
Total digestible nutrient						
TDN1x (%)	80.23	79.45	82.20	0.798	0.2102	0.8631
Predicted energy (Mcal/kg DM) at production level of intake (3X) (NRC dairy model 2001)						
DE3x (Mcal/kg DM)	3.2362	3.1862	3.3247	0.03403	0.1889	0.7667
ME3x (Mcal/kg DM)	2.8258	2.7727	2.9210	0.03500	0.1861	0.8277
NEL3x (Mcal/kg DM)	1.8040	1.7640	1.8773	0.02646	0.1842	0.7745
Predicted energy (Mcal/kg DM) at production level of intake (4X) (NRC dairy model 2001)						
DE4x (Mcal/kg DM)	3.0924	3.0446	3.1769	0.03434	0.2100	0.7667
ME4x (Mcal/kg DM)	2.6806	2.6297	2.7718	0.03500	0.1861	0.8277
NEL4x (Mcal/kg DM)	1.7017	1.6633	1.7720	0.02466	0.1615	0.6857
Net energy estimated from NRC beef model 1996						
ME (Mcal/kg DM)	2.8896	2.8449	2.9685	0.03500	0.2341	0.8277
NEm (Mcal/kg DM)	1.9398	1.9023	2.0055	0.02466	0.1911	0.6857
NEg (Mcal/kg DM)	1.2947	1.2623	1.3511	0.02263	0.1948	0.8297

SEM=standard error of mean. Means with the different letters in the same row are significantly different ($P<0.05$).

Protein and carbohydrate fractions

Protein and carbohydrate fractions determined by the CNCPS system (Sniffens et al 1992; Licitra et al. 1996) are shown in Table 5.

CDC SO-I oat had similar protein fractions as CDC Dancer and Derby except for PB2. Considerably less PB2 (%CP) in CDC SO-I was observed than for CDC Dancer and Derby, indicating less slowly digestible protein and more for rumen microbial protein synthesis.

CDC SO-I oat had less total CHO and CC fraction, but higher CB2 fractions than CDC Dancer and Derby. The results indicated that CDC SO-I had more slowly digestible carbohydrate and less undigestible carbohydrates associated with the cell walls than CDC Dancer and Derby.

Compared to the barley study using CNCPS by Yu et al. (2003), oat had more PA+PB1+PB2 and less PB3 and PC fractions. Such results suggest that oat has more readily degradable CP in the rumen.

Table 5. Protein and carbohydrate fractions (CNCPS) of different cultivar of oats

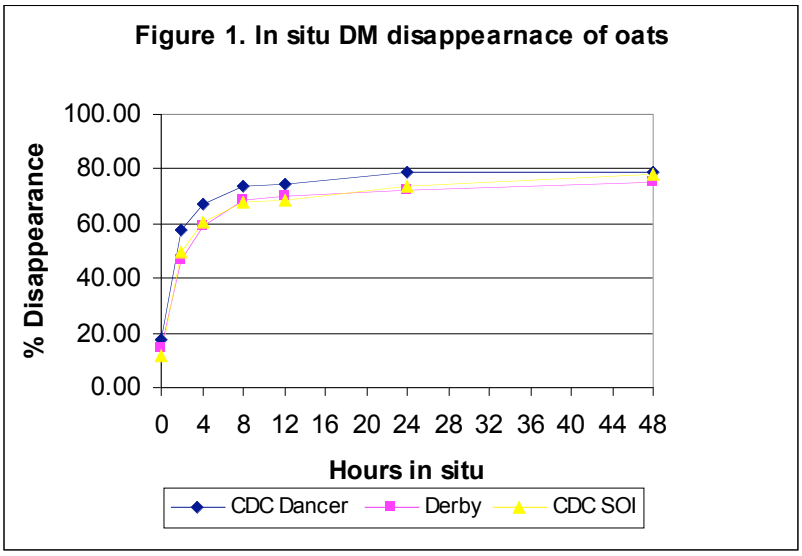
	Oats					
	CDC Dancer	Derby	CDC SO-I		P value	
Items				SEM	Oat	Year
Protein fractions						
PA (%CP)	13.43	9.88	15.62	1.569	0.227	0.118
PB1 (%CP)	30.00	36.17	37.51	3.311	0.406	0.461
PB2 (%CP)	46.17a	47.01a	40.38b	0.510	0.020	0.976
PB3 (%CP)	5.34	2.38	2.32	0.701	0.141	0.284
PC (%CP)	5.07	4.57	4.18	1.636	0.932	0.941
True Protein						
TP (%CP)	81.51	85.55	80.20	2.948	0.528	0.305
PB1 (%TP)	36.79	42.20	46.38	2.588	0.216	0.656
PB2 (%TP)	56.65	55.01	50.57	2.359	0.360	0.402
PB3 (%TP)	6.56	2.79	2.81	0.850	0.133	0.311
PA (%DM)	1.59	1.09	2.01	0.239	0.214	0.189
PB1 (%DM)	3.54	4.03	4.80	0.411	0.295	0.355
PB2 (%DM)	5.46	5.22	5.17	0.124	0.395	0.297
PB3 (%DM)	0.63	0.26	0.30	0.082	0.140	0.233
PC (%DM)	0.60	0.51	0.54	0.196	0.942	0.896
Carbohydrate fractions						
CHO (%DM)	80.44a	81.75a	77.77b	0.419	0.041	0.202
CA (%CHO)	11.65	16.65	5.39	3.104	0.233	0.444
CB1 (%CHO)	56.89	49.30	54.74	2.347	0.265	0.441
CB2 (%CHO)	19.80c	23.51b	33.35a	0.508	0.005	0.207
CC (%CHO)	11.67a	10.55a	6.53b	0.498	0.033	0.685
CA (%DM)	9.38	13.59	4.20	2.392	0.206	0.422
CB1 (%DM)	45.76	40.31	42.57	2.050	0.359	0.583
CB2 (%DM)	15.93c	19.22b	25.93a	0.488	0.009	0.370
CC (%DM)	9.39a	8.63a	5.08b	0.446	0.036	0.597

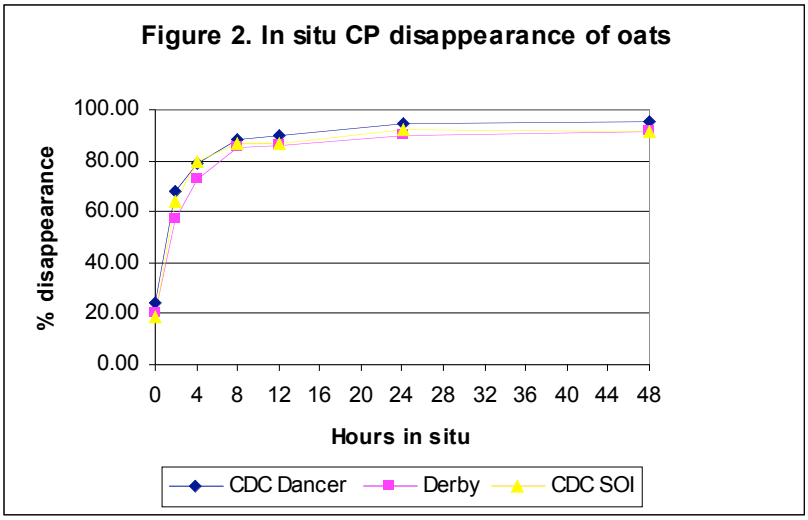
SEM=standard error of mean. Means with the different letters in the same row are significantly different ($P<0.05$).

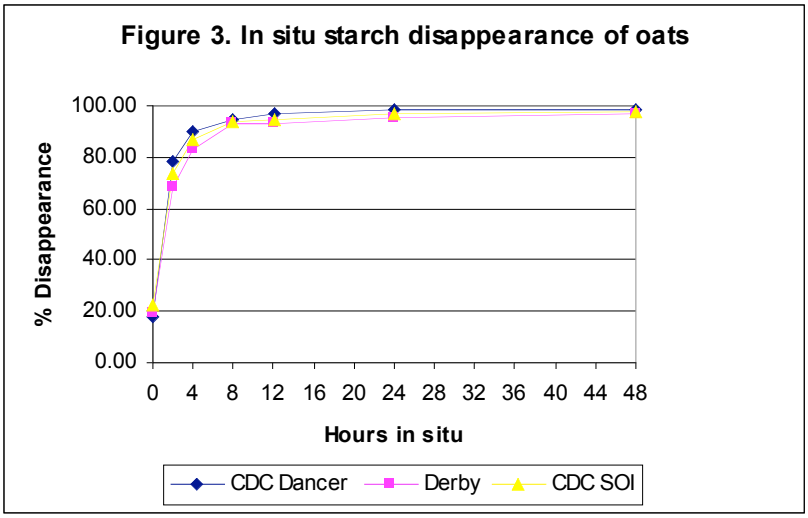
In situ rumen degradability of DM, CP and starch of oats

In situ DM, CP and starch disappearance are illustrated in Figure 1, Figure 2 and Figure 3, respectively. DM, CP and starch of oats showed similar trends in terms of in situ disappearance. During the first 2 h, DM disappearance were 57.90% for CDC Dancer, 46.7% for Derby and 49.6% for CDC SO-I; CP disappearance was 67.89% for CDC Dancer, 56.84% for Derby and 63.80% for CDC SO-I; starch disappearance was 78.67% for CDC Dancer, 68.17% for Derby and 73.50% for CDC SO-I. These characteristics of nutrient disappearance are similar to those reported by Herrera-Saldana et al. 1990. They observed that oat had highly degradable fraction of DM, CP and starch, about 80% DM and greater than 90% of total CP and starch in oat disappeared during the first 2 h of rumen incubation. It is indicated that oat contained a highly degradable fraction which disappeared before 2h; thereafter, DM was degraded more slowly reflecting slow degradation of fibre from oat (11.83-13.93% ADF). For CP disappearance, it is possible that globulins are highly degradable and constitute about 80% of total protein; while the

starch is floury type made up of simple and complex granules which are rapidly degraded in the rumen (Herrera-Saldana et al. 1990).







CONCLUSION

Chemical analysis revealed that CDC SO-I had more digestible fibre than conventional oat due to lower acid detergent lignin and non structural carbohydrate.

CDC SO-I oat contained similar protein fractions as CDC Dancer and Derby except for PB2. Considerable less PB2 (%CP) in CDC SO-I was observed, indicating less slowly digestible protein and more for rumen microbial protein synthesis.

CDC SO-I oat had less total CHO and CC fraction, but higher CB2 fractions than CDC Dancer and Derby. The results indicated that CDC SO-I oat had more slowly digestible carbohydrate and less undigestible carbohydrates associated with the cell walls than CDC Dancer and Derby.

CDC SO-I had similar energy values as barley, suggesting that CDC SO-I could be a good alternative as an energy concentrate in dairy and beef rations.

The in situ trial revealed that nutrient disappearance of DM, CP and starch followed the same trend. Information obtained may help understand relative protein and starch degradability of oats in the rumen. It may also allow for combinations of energy and protein supplements for improved efficiency of nutrient utilization and improvement in animal performance.

To better understand ruminant feeding characteristics of CDC SO-I, further study is needed re modeling nutrient supply, rumen degradation characteristics, microbial protein synthesis in the rumen, intestinal digestion of oat-containing feed and microbial protein and degraded protein balance.

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